

FDA's Team Tomato Fights Contamination

A fresh tomato is more than just a tasty addition to a sandwich or salad.

To scientists at the Food and Drug Administration (FDA), the tomato is an enigma and the focus of a group of researchers nicknamed "Team Tomato."

The mystery of the tomato has to do with its vulnerability to contamination by *Salmonella*, a bacterium that is a common cause of foodborne illness.

From 1973 to 2010, there were 15 multistate outbreaks of illnesses attributed to *Salmonella* contamination of raw tomatoes, with 12 of these outbreaks taking place since 2000. They resulted in almost 2,000 confirmed illnesses and three deaths, with states in the eastern U.S. hardest hit.

"The conditions in which tomatoes thrive are also the conditions in which *Salmonella* thrive," says Eric Brown, Ph.D., director of FDA's Division of Microbiology. "But the tomato always presented an extra challenge because it is so short-lived. By the time it looked like contaminated tomatoes could be causing illnesses, the harvest would be gone."

So FDA's focus has changed over the last decade to reducing contamination early in tomato production. Says Brown, "The question was clear: What can we do to intervene and prevent this contamination from happening in the first place?"

New Research

FDA microbiologist Rebecca Bell, Ph.D., lead researcher on the tomato team, says the agency studies toma-



FDA Photo by Michael J. Ermarth

Research microbiologist Rebecca Bell observes tomatoes suspended in a plastic bag of a liquid containing nutrients that make it an ideal environment for growing bacteria.

atoes on an experimental farm at Virginia Tech's Agriculture and Research Extension Center (AREC). This land is next to farms that have been the source of *Salmonella* contamination, giving the researchers access to real conditions and real threats.

The researchers collected more than a thousand bacteria in the soil and water in search of a natural enemy of *Salmonella* and they found one—a bacterium called *Paenibacillus*, which is benign to humans but kills *Salmonella*. FDA will be working with the Environmental Protection Agency (EPA) to facilitate the development of an organic treatment containing *Paenibacillus* that would kill *Salmonella* and other harmful organisms.

Bell says this will be a particularly valuable *Salmonella*-fighting tool in the mid-Atlantic region, where farmers often fumigate six inches down into the soil to kill harmful bacteria. Their methods for doing so may, ironically, create more opportunities for enteric pathogens (gastrointestinal organisms spread by contamination of food), such as *Salmonella*, to colonize in the roots of the tomato plants.

Published Studies

FDA researchers on this team follow parallel tracks towards the same goal of helping government and industry develop more effective and targeted agricultural practices that will improve the safety of fresh tomatoes.

Two examples of their work have been published this year in prominent professional journals.

- In a study published in the *Journal of Applied and Environmental Microbiology*, microbiologist Jie Zheng, Ph.D., and other FDA researchers explain how they set out to better understand how fresh tomatoes become contaminated with *Salmonella*. The researchers found that quality of the water is a key factor. Tomatoes can become contaminated at specific times during the growing season,



FDA photo by Michael J. Ermarth

Researchers Tim Muruvanda (left) and Sasha Gorham study the genetic makeup of *Salmonella*.

indicating the importance of using clean water to irrigate at planting or when applying pesticides.

- In a study published in the journal *BMC Microbiology*, microbiologist Andrea Otteson, Ph.D., and FDA colleagues compared the tomato-growing environments of California, Virginia and Florida. The researchers are developing a baseline of microflora (including algae, fungi, and bacteria) associated with tomato crops at high or low risk of *Salmonella* contamination. The researchers are also considering other factors, such as the crops' proximity to poultry farms—a potential source of *Salmonella*—or certain fungi in the soil. California has not had

as many *Salmonella* outbreaks in tomatoes, and this research may be able to pinpoint the conditions on the East Coast that would be the safest for tomato crops, Otteson says.

The Practical Application

So what does FDA do with all this information?

The agency's tomato research is shared on an ongoing basis with industry and agricultural extension systems at the state level. Steve Rideout, Ph.D., director of Virginia Tech's AREC, says that he and his staff exchange research findings with FDA and share that information with growers.

"There are still a lot of unknowns when it comes to contamination of

tomatoes,” says Michael Mahovic, Ph.D., a consumer safety officer on FDA’s Produce Safety Staff. “But our research helps open a window.”

Findings by FDA researchers were among the building blocks of the Proposed Produce Safety Rule mandated by the FDA Food Safety Modernization Act (FSMA), Mahovic says. The proposed rule would establish science-based standards for the production and harvesting of fruits and vegetables. FSMA gave FDA a mandate to implement a system that emphasizes prevention of risks to public health.

The tomato industry has worked closely with FDA in setting its own safety standards, says David Gombas, Ph.D., senior vice president of the United Fresh Produce Association. Industry-wide safety guidelines were adopted in 2008. And in 2009, the industry issued food safety and auditing standards, commonly called the Tomato Metrics, for growers, greenhouse operators, and packers.

Mahovic says FDA used these industry standards as the basis for its own draft guidance documents in 2009 that recommended ways in which microbial food safety hazards could be reduced throughout the tomato supply chain.

Gombas says the tomato industry continues to have a close working relationship with FDA, with frequent meetings and conversations about the latest research. The industry provides FDA access to farms and crops. “We’re all working together on this,” he says.

Studying the Genes

There is another arm of this work for Team Tomato—researching the genes of the disease-causing bacteria. While the agency’s other research in field and lab focuses on preventing tomatoes from becoming contaminated, the goal of the gene research is to prevent illnesses once *Salmonella* is detected.

FDA wants faster ways to track down the source of an outbreak of foodborne illnesses, explains Captain



FDA photo by Michael J. Ermarth

Researcher Tim Muruvanda sequences *Salmonella* genes to compare the DNA of different strains of the bacteria.

Thomas Hill, MPH, U.S. Public Health Service, an environmental health specialist in FDA’s Coordinated Outbreak Response Network, who is also a member of Team Tomato. “I come at this from the outbreak perspective. Part of our mission is to prevent the next outbreak.”

Bell explains that the agency has been developing bacterial genetic sequences (the ordered chemical building blocks of DNA). This work will be part of a public database of bacterial gene sequences that will allow scientists to rapidly identify disease-causing bacteria and locate their source. “There has been a big data gap in the past, and we’re looking to correct that,” says Bell.

Sound Science

In addition to its focus on the prevention of foodborne illnesses, Team Tomato’s work advances another FDA priority: the use of sound science—in this case what we call regulatory sci-

ence—to support the agency’s oversight of the nation’s food supply.

“Team Tomato is one of the best examples of regulatory science that we have to offer,” says Brown. “The scientific information that Team Tomato has gleaned so far is helping to answer some very tough questions related to tomato safety and *Salmonella* in the farm environment.”

Brown notes, “Considering the number of people who eat tomatoes, the rate of infection from *Salmonella* is very low. But it’s a very popular food, and we are determined to make that risk as low as possible.” **FDA**

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